Process Safety Management Framework

Essential attributes to meet process safety outcomes

BRITISH SAFETY COUNCIL

Because Experience Counts

Process Safety Management Framework

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Process Safety Management Framework

Introduction

Process Safety Management encompasses the measures and arrangements high hazard companies have in place to prevent a loss of containment of a hazardous substance or a loss of control of a hazardous condition which could give rise to a serious accident or incident. This also includes the measures we adopt to reduce the impact or severity of an incident should one occur.

Many industries harness and use hazardous substances or hazardous conditions to generate profit and deliver successful business outcomes. For high hazard industries, meeting the requirements of this framework is not an option if you wish to avoid the chance of a catastrophic incident. The evidence for these adverse outcomes is everywhere and major incidents continue on a daily basis. Hazards don't care whether we are organised and systematic in how we contain or control them. Gasoline, LPG, LNG, chlorine gas and similar hazardous substances never take a day off as being a hazard. High tension electricity will every second of every day seek the shortest conductive route to ground. So, we also cannot either take a day or a minute's pause in how we control such useful hazards.

This framework sets out good practice on risk management within the business. There are 14 Elements to this Framework and for each there is an objective and purpose as well as a minimum set of expectations on the arrangements and controls which need to be in place at all high hazard facilities and within all high hazard operations. All the elements are required and there is no prioritisation on which is most important because they all work in tandem to deliver excellence in risk management.

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Ian Travers Limited, 2020

Integrated risk management

The Process Safety Management Framework does not introduce any new concepts or control measures in how most organisations manage process safety risks, it simply reflects and makes explicit what has always been expected to be in place to manage the risk of a major incident. Compliance with the Framework is compatible with and complements excellence and efficiency in production, asset management, waste management and environmental protection. These combined requirements provide a high-level of business assurance in the control of risk.

How to use the framework

Each Element has a minimum set of expectations which have to be in place to provide a high-level of assurance that risks are effectively managed. The Framework does not provide explicit information on how to meet these requirements. This allows for flexibility within facilities and operations to meet these requirements.

Process Safety Framework Overview

The Process Safety Management framework is shown in Figure1. It is based on current international best practice guidelines such as the Energy Institute's Process Safety Framework and the Centre for Process Safety Guidelines for Process Safety.

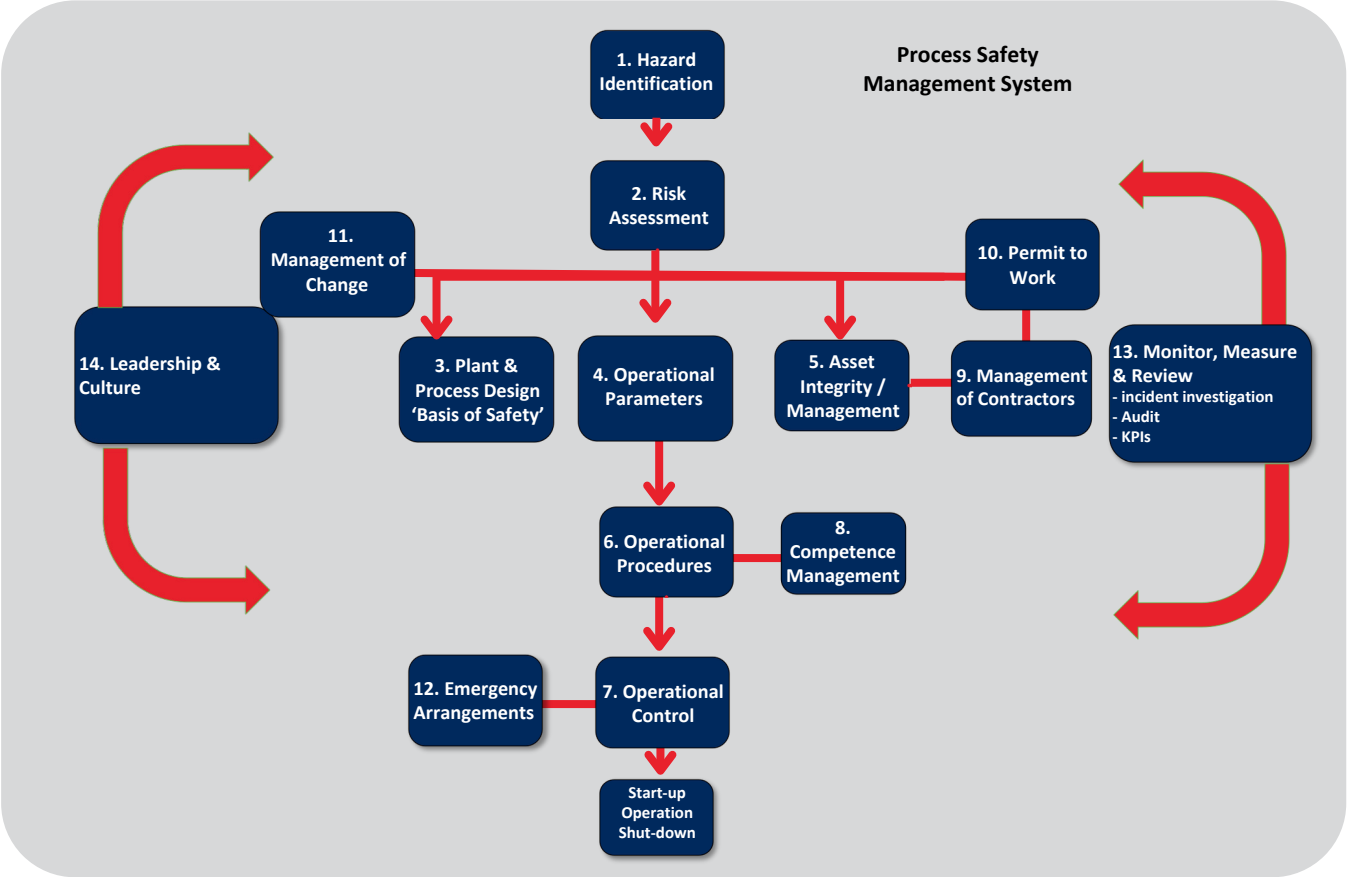

Figure 1. Process Safety Management Framework

The framework follows a logical sequence from Hazard Identification through to establishing and maintaining Operational Control together with supporting arrangements such as Monitoring and Review and Leadership and Culture. This flow-through structure helps understanding of the purpose of each element

and how the system works overall. Each element is supported by an underlying outcome statement which shows the objective, in terms of risk control, of each component.

The framework involves the organization asking itself:

- What could go wrong?
- When and Where could it go wrong?
- What systems and procedures are in place to prevent things going wrong?
- Which are the most important control measures and how reliable are they?
- information is routinely collected to show each system continues to function as required?

Process Safety Framework Elements

1. Hazard Identification

Purpose: To ensure that all types of harm or danger which can give rise to a catastrophic failure or major incident are identified and quantified. The organisation of this information into specific scenarios which cover how a hazard may give rise to a major incident, in what circumstances, where or when in terms of location and activity and to determine the initial consequences in terms of susceptible people, assets and the environment.

Minimum Expectations:

1.1 Complete Inventory: All hazardous substances and hazardous conditions (stored energy, rotating machinery, high tension electricity, high temperatures and pressures) are identified and quantified. This information is kept in a hazard register. The register contains information of the hazardous properties (GHS, CAS, UN number or ECHA registration) of all hazardous substances. The location of plant and equipment which contains hazardous substances, or which involves hazardous conditions are identified and documented.

1.2 Hazard Scenarios Identified: Scenarios which could give rise to major accident or incident from the hazardous substances, plant, equipment or assets are identified and documented. The scenarios should set out the worst-case incidents for the plant/facility together with the potential adverse consequences in terms of extent and severity of an incident.

1.3 Information on Hazards Made Available: Information on the nature of dangerous substances, hazardous conditions and hazard properties is available to all persons working on the site, including contractors, in a way which can be easily understood by them. The information should provide details of how and where to store each hazardous substance. The information should be in a format which can be used in a risk assessment. This information should include the action to take in the event of a loss of containment or loss of control of hazardous plant.

1.4 Control of Inventory: There should be a system in place to control the acquisition of hazardous substances and to control any substantial changes of inventory of hazardous substances on site. Changes in volume or hazard category should be managed within the Management of Change system.

1.5 Safe Storage/Segregation: Incompatible materials should be stored in a segregated area according to their hazard classification. Flammable materials should be stored outdoor wherever possible in a bunded area. Where they are stored inside the storage area should be in a bunded area which is well ventilated. A hazardous area classification under ATEX should determine the safe distances from sources of ignition or the classification required for electrical equipment within storage areas.

1.6 Permits and Licences: The types and volumes of substances stored on site should be in accordance with any permits, licences or environmental restrictions which apply to the facility. Registration or notification of dangerous or hazardous equipment, machinery and vessels together with hazardous facilities should also comply with any statutory requirements.

1.7 Review of Inventory: A routine review and audit of the inventory of hazardous substances should be undertaken to ensure that the volume and nature of materials held on site matches that of the documented inventory and is within the restrictions of any licence or permit. The review frequency should be set by the Facility or Business Unit based on the rate of change of hazardous substances or materials. Where there are few changes or acquisitions of new substances the review should be undertaken every three years. For facilities with a higher rate of substance change then the review should be undertaken at least annually.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
    - Copies of the hazard scenarios for the facility,
    - Details of the current hazard register
    - A copy of a Management of Change assessment associated with the change in the volume or nature of hazardous substance stored at the facility.
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 6: Hazard Identification and Risk Assessment
2. HSE Guidance: Identify the Hazard, https://www.hse.gov.uk/risk/identify-the-hazards.htm
3. HSE Guidelines: HSG 71: Chemical Warehousing – The storage of packaged dangerous substances: https://www.hse.gov.uk/pubns/priced/hsg71.pdf
4. HSE Guidance: HSG176- The storage of flammable liquids in tanks. https://www.hse.gov.uk/pubns/priced/hsg176.pdf
5. HSE Guidelines: HSG51: The storage of flammable liquids in containers; http://www.hse.gov.uk/pUbns/priced/hsg51.pdf
6. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 9: Hazard Identification and Risk Analysis. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-1. 6569-0

2. Risk Assessment

Purpose: To determine the consequences of a catastrophic incident, what the initiating events for such an incident are and to then determine the control and mitigation measures required to reduce the likelihood of a catastrophic event to an acceptable level throughout the entire life cycle of the installation.

Minimum Expectations:

2.1 Structured and Systematic Risk Assessment: A structured and systematic risk assessment framework is in place to identify and assess major accident hazards and process safety risks. The risk assessment methodology applied should be suitable for the process, conditions and failure modes, including human failure, associated with each Hazard Scenario identified in Element 1: Hazard Identification.

2.2 Scope: All hazard scenarios have been subject to a structured and proportionate risk assessment to determine the controls and mitigation measures required to reduce risks to as low as is reasonably practicable, ALARP.

2.3 Methodology: The structured risk-assessment identifies and records the initiating events, challenges to the integrity of plant/process and failure modes, including human failure, which could give rise to each Hazard Scenario in Element 1. Risk assessments determine the likelihood of each of the major accident/incident scenarios. This includes modelling of the on and off-site consequences of a major accident/incident. Risk assessments consider risks to:

- employees, contractors, members of the public;
- the environment (inside and outside fence);
- asset integrity; business interruption; security;
- third party assets, and customers.

Human factors and human reliability are taken into account within the risk assessment as well as learnings from incidents from both inside and outside the organisation.

2.4 ALARP and Risk Reduction: Where risks are determined not to be as low as reasonably practicable then a time-bound action plan is in place to eliminate the hazards or to reduce the risks to ALARP. The assessment of risk utilises a risk reduction hierarchy including; elimination, substitution, control and then protection. A risk matrix is used to determine acceptable risks and residual risks once controls and mitigation measures have been implemented and recorded on the risk matrix. Actions and improvements determined by risk assessments should be prioritised in terms of their importance and contribution to risk reduction and recorded in a Risk Improvement Plan for the facility.

2.5 Determination of Design, Operational Parameters and Maintenance Programmes: Risk assessment is first used to determine the design of the plant and processes, the safe operating parameters, safety criticality and the maintenance programmes required to maintain the integrity of the plant and the process during all foreseeable circumstances whilst hazardous substances or hazardous conditions are present. This 'Basis of Safety' is recorded and understood by those operating and maintaining the plant and equipment and transferred into operating and maintenance procedures and protocols. Once operational, risk assessment is used during changes to plant, equipment, operating procedures and maintenance protocols. Risk assessment is also a key stage in the development of new tasks and activities where there could be a significant loss of containment or a serious process safety incident.

2.6 Recording and Communication of Findings: The findings of risk assessment are recorded, made available and understood by all staff at the facility. The outcomes of structured risk assessments are documented and

communicated to relevant staff. Other stakeholders are kept informed about the risk assessment process and results.

2.7 Competence: Risk assessment should be undertaken by people who are trained and competent in the methodology utilised. Where appropriate, due to the complexity of the process or activity, a risk assessment should be undertaken by a multi-disciplinary team and approved by the person responsible for the establishment or designated by the facility or business unit management team.

2.8 Review and Revision: Risk assessments should be routinely reviewed and updated. This includes consideration of the findings and lessons from incidents and accidents on the site and at other assets across the business?

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o Examples of consequence and likelihood modelling for two major accident/incident scenarios at the facility,
  - o Copies of the completed risk matrix record of the residual risks at the facility,
  - o Examples or a sample of recent risk assessments completed within the last 3 years at the facility,
  - o Copy of the risk improvement plan for the facility.
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure to effectively assess risks was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 6: Hazard Identification and Risk Assessment
2. HSE Guidance: ALARP: https://www.hse.gov.uk/risk/theory/alarpglance.htm
3. HSE Guidance: ALARP Expert Advice: https://www.hse.gov.uk/risk/expert.htm
4. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 9: Hazard Identification and Risk Analysis. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-1. 6569-0

3. Plant Design

Purpose: Utilising the results of risk assessment to determine the 'basis of safety' required to prevent a catastrophic incident and then to design, construct and commission the facility to ensure that the risk reduction/mitigation objectives are effectively implemented. Ensuring there is accurate information and records of the design specification, the rationale for selecting particular safeguards, control systems and design. To ensure that essential process safety information is secured and available for those who may require it.

Minimum Expectations:

3.1 Design Objectives and Basis of Safety: The plant, equipment and process design provide for inherently safe operations. The design objectives for the plant and processes are clearly stated and understood by those who operate and maintain the plant. This could be recorded as a set of scenario descriptions such as; "The plant is designed to automatically shut down or assume a safe stable state in the event of any extreme process conditions beyond the safe operating margin. In the event of a loss of containment or loss of control of a hazardous condition a plant shut down can be initiated by following a designated procedure or protocol".

3.2 Plant Integrity and Failure Modes: The plant, equipment and control systems are designed to withstand challenges to integrity during the normal lifecycle of the plant, including consideration of plant ageing. The challenges to integrity and the plant and process failure modes, including human failures, are identified during risk assessment are documented and made available to those who operate and maintain the facility.

3.3 Safe Lifecycle: The plant and processes are designed to facilitate a safe start up, operation and shut-down cycle. The plant can be started up without overriding any safety critical instrument, controls or devices. A start-up sequence can be abandoned at any stage without endangering the integrity of the plant or equipment or the safety of those operating it. The plant is designed to automatically shut down in the event of any extreme process conditions beyond the safe operating margin. Where this is not reasonably practical then there are documented and understood protocols on how to safely shut down the plant and processes.

3.4 Safe Isolation: The plant and processes are capable of being safely isolated when shut down.

3.5 Design Meets Appropriate Codes and Standards: The selection of materials, equipment, process controls, instruments, alarms and safety devices meet recognised national or international standards and codes appropriate for the dangerous substances, conditions and process parameters expected throughout the lifetime of the facility. The design codes associated with the installation are documented and available to staff who operate and maintain the plant.

3.6 Design Life: The maximum expected design life of the plant and equipment is specified and recorded in an Asset Register. Utilisation beyond design-life is subject to a risk assessment and Management of Change procedure.

3.7 Safety Critical Plant and Equipment: Safety critical plant and equipment are identified, tagged and recorded in an Asset Register. The function and performance requirements, such as SIL level, response time and calibrated accuracy, of each device and equipment is documented.

3.8 Human Factors: Human factors and the need to minimise the opportunity of human error and fatigue is taken into account in the plant design, layout, ease of operations and process environmental conditions such as noise, heat, light and humidity. Plant and equipment are clearly labelled or signed to ensure its identification and correct usage, isolation and hazardous status.

3.9 Information and Alarms: The plant and process design provide sufficient operation information and alarms to enable the plant to be run within the designated operational parameters and to provide sufficient and timely warning of abnormal or emergency situations. Information on the process conditions, plant status and maintenance of safety margins is presented to the operators and plant controllers in a clear and consistent manner. There is an Alarm Management Strategy which sets out the rational for process and safety alarms, alarm prioritisation and avoidance of alarm overload. Alarm loading and alarm rates are monitored and trends analysed to show where alarm overload may be occurring.

3.10 Safety Instrumented Systems: All safety instrumented systems provide the appropriate level of integrity based on the potential major accident scenarios and the appropriate level of reliability needed to reduce risks to ALARP. All safety instrumented systems are tested and validated in accordance with BS EN 61511 (or equivalent) prior to being brought into operation.

3.11 ATEX and Hazardous Area Classification: All hazardous zones been identified, documented and recorded on a site plan. Appropriately rated ATEX equipment provided in hazardous zones (0, 1 & 2).

3.12 Reliable Utilities: Reliable utilities needed to support safe operations, shut down and emergency provision are provided. Essential utilities have suitable back-up systems to ensure that power and services can be maintained in the event of a loss of primary systems.

3.13 Cyber Attack and Security: The plant, process, equipment, control systems and utilities are designed to resist a cyber-attack or malicious external interference and to remain in a safe condition if challenged. There adequate site security and safeguarding, such as fencing, access control, CCTV and security staff as appropriate based on the location and practicality, to prevent trespass or criminal access.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and update the following information:
  - The design objectives for the plant and processes,
  - Information on the challenges to integrity and the plant and process failure modes identified during Risk Assessment for the facility,
  - Examples of the isolation methods and sequences plant or process units,
  - Alarm loading and alarm rates monitoring results and trend analysis,
  - The ATEX hazardous area classification maps / documents.
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure of the plant design, including human error due to plant design, was found to be an underlying cause or contributing factor to the incident,
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 2: Identification and Compliance with Legislation and Industry Standards, E7: Documentation, Records and Knowledge Management, E11: Standards and Practices, E16: Management of Safety Critical Devices.
2. HSE Guidance: RR823 Managing Aging Plant. https://www.hse.gov.uk/research/rrpdf/rr823-summary-guide.pdf
3. HSE Guidance: COMAH; Aging Plant Operational Delivery Guide https://www.hse.gov.uk/comah/guidance/ageing-plant-core.pdf
4. HSE Guidance: HSG253 The Safe Isolation of Plant and Equipment. https://www.hse.gov.uk/pubns/priced/hsg253.pdf
5. ALARP: https://www.hse.gov.uk/risk/theory/alarpglance.htm
6. HSE Guidance: ALARP Expert Advice: https://www.hse.gov.uk/risk/expert.htm
7. BS EN 61508, **Functional safety of electrical/electronic/programmable electronic safety related systems. ISBN:** 978 0 580 96268 4. https://shop.bsigroup.com
   Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 4: Compliance
8. Standards, E12: Asset Integrity and Reliability. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-1. 6569-0

4. Operational Parameters

Purpose: To determine the operational arrangements and conditions to ensure that the 'basis of safety' from design is maintained during all normal and abnormal operation conditions, including start up and shut down.

Minimum Expectations:

4.1 Safe Operating Envelop: The safe operational parameters should reflect the basis of safety designated by the plant and process design. The safe operating envelop for each process should be clearly specified and documented. Safety margins and transition points between normal and abnormal status should be specified.

4.2 Alarm and Control Configuration: The alarm and control system configuration should reflect the 'basis of safety' from risk assessment and plant design. It should include sufficient safety margins to provide an alert when the integrity of the plant or process is potentially challenged and degraded both in the short term and long-term functioning of the plant. The Alarm Management Strategy determines the presentation of critical alarms and information so that alarm overloads and false alarms are eliminated or minimised.

4.3 Documentation and Communication: The safe operational parameters are effectively communicated to operators and maintenance staff. The operational parameters should be recorded on relevant PID diagrams and documents. The operational parameters set out in procedures and job-aids should align with the specified plant design operational parameters and safe operational limits.

4.4 Plant Status Information: The status of the plant and processes together with the correct valve positions, pump status and product flows, temperatures, levels and pressures etc. should be provided to control room staff and available on the plant to allow operators to maintain the correct operational conditions.

4.5 Start up and Shut Down: The safe operational parameters should cover conditions expected during start-up and shut down of the process, plant and equipment.

4.6 Review: Adherence to safe operating parameters and designated safety margins should be routinely reviewed by the Facility or Business Unit Management team to ensure that sufficient safety margins are actually maintained and that safety systems are able to effectively respond to dangerous changes in operational conditions.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o A copy of the Alarm Management Strategy,
  - o Examples of PIDs and operational procedures which show the safe operating parameters,
  - o Information which demonstrates compliance with the designated operational parameters and highlights significant or routine excursions beyond the specified limits.
- Once every 3 years conduct an independent audit (by a person external to the facility / business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure in safe operational parameters was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 9: Process and Operational Status Monitoring & Handover, E10: Management of Operational Interfaces.
2. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 17- Control of Operations. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-1. 6569-0

5. Asset Management

Purpose: To ensure the integrity and performance of plant, equipment, sensors and alarms are within the acceptable levels of performance to maintain the 'basis of safety' at all times hazardous substances or conditions are present. To facilitate careful monitoring of delivery of maintenance programmes and the collection of intelligence on the function of plant and equipment.

Minimum Expectations:

5.1 Risk-Based Asset Management: There should be a systematic and risk-based inspection and maintenance programme in place. Inspection protocols and maintenance frequencies should be based on the expected failure modes and degradation intervals of plant and equipment and take account of ageing plant issues.

5.2 Plant Integrity and Failure Modes: The failure modes, degradation in performance profiles of plant, equipment, utilities and control systems which could give rise to a loss of containment or a loss of control of a hazardous condition should be recorded and available to all staff who operated and maintain the plant.

5.3 Standards and Codes: The inspection, maintenance and asset management programme should be based on recognised national and international codes and standards such as ISO 55000 series and should adhere to the recommendations of equipment manufacturers and suppliers. Deviations in adherence to recognised codes and standards or with manufacture's and supplier's recommendations should be subject to a risk assessment and the findings and justification recorded.

5.4: Asset Register: An Asset Register and information system contains the identification and criticality of all process safety equipment, critical utilities, safety devices and instrumentation.

5.5 Safety Critical Plant: All items of safety critical plant, equipment, utilities and control systems are identified and distinguished from operational critical plant and equipment. Prioritisation of inspection and maintenance actions is based on the safety function and criticality of the plant and equipment.

5.6 Critical Structures and Supports: The asset management programme should include the inspection and maintenance of structures and plant / pipework supports.

5.7 Functional Testing: Functional and life-cycle performance tests in accordance with BS EN 61511 should be undertaken on all safety critical programmable electric systems.

5.8 Critical Spares: Safety critical spares should be identified and recorded in a Critical Spares Register. Critical spares recorded in the register should be kept on-site or in close proximity to the facility. There should be a procurement and inventory management system to ensure that replacements are ordered when stock is used.

5.9 Safe Isolation: Isolation methods and sequences for each plant, equipment, utilities and services are documented and clearly labelled and identified at their location. Isolation methods and sequences meet international standards and good practice such as HSG253 The Safe Isolation of Plant and Equipment.

5.10 Plant Condition Monitoring: Plant and equipment condition monitoring used where appropriate to detect early signs of failure of safety critical items**.**

5.11 Competence: Inspection and maintenance activities are undertaken by competent staff/ contractors. For staff their role, experience and competence in relation to maintenance is set out in their job-specification. For contractors the minimum level of experience and competence is set out in the contract/procurement document.

5.12 Contracted Out Inspection and Maintenance: Where the maintenance or inspection of plant, equipment, utilities or control systems is undertaken by a contractor then the work should be recorded in a written scheme of inspection, examination and maintenance. This written scheme should include the scope of the work and details of the performance characteristic of the items being assessed. The results of the inspection and maintenance actions should be recorded together with a statement of whether the item can safely continue in service until the next planned check.

5.13 Performance Data and Intelligence: Data should be collected from operations and maintenance and analysed against design performance criteria to demonstrate the effective functioning of plant, equipment and control systems or to highlight improvements. **5.14 Performance Management:** Delivery of the asset management programme is monitored and reviewed
by the facility management team. Overdue maintenance actions for safety critical plant and equipment are assessed to determine whether the plant and process can continue to meet its 'basis of safety' until such point as the outstanding item(s) is cleared. The decision to continue to operate with overdue safety critical inspections and maintenance actions should be recorded and endorsed by the facility management team.

Demonstrating Compliance: To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o An abstract from the Asset Register showing the identification of safety critical plant and equipment,
  - o Copies of functional test reports on SIL rated safety systems
  - o The latest maintenance progress report showing any overdue inspections or maintenance checks on safety critical items.
  - o Examples of intelligence reports from inspection and maintenance indicating current performance data and maintenance of safety margins for safety critical equipment.
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure in maintenance was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 15: Inspection and Maintenance, E16: Management of Safety Critical Devices.
2. HSE Guidance: RR823 Managing Aging Plant. https://www.hse.gov.uk/research/rrpdf/rr823-summary-guide.pdf
3. HSE Guidance: HSG253 The Safe Isolation of Plant and Equipment. https://www.hse.gov.uk/pubns/priced/hsg253.pdf
4. ISO 55000:2014. Asset Management – Overview, Principles and Terminology https://www.iso.org/standard/55088.html

5. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Asset Integrity and Reliability. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-1. 6569-0

6. Operational Procedures

Purpose: To ensure that adequate information and instructions are provided to plant operators, maintenance staff and contractors to ensure that plant and processes can be operated within the safe operating limits during normal and abnormal conditions. Identification of safety critical tasks within operational procedures to ensure that those involved are aware of their importance and the performance standards required. Design of procedures takes account of human factors and performance influencing factors.

Minimum Expectations:

6.1 Policy: There should be a written Policy which sets out where and for what types of activities operational procedures are expected to be in place. The Policy should state how Operational Procedures are to be formatted, promulgated and reviewed.

6.2 Scope: Operational procedures should be in place for all of the activities set out in the Policy. They should cover start-up, operation, simultaneous operations and shutdown of plant and processes and maintenance of the integrity of plant and processes. Operational Procedures should accurately reflect the safe operational parameters established under Element 4. Operational procedure should cover abnormal conditions and emergency shut-down arrangements. Operating procedures should cover the actions and activities taken to maintain control when there is an expected or unexpected process deviation.

6.3 Roles and Responsibilities: The roles and responsibilities for those responsible for the development, communication and review of operational procedures should be clearly set out and reflected within the individual's job descriptions. Each Operational Procedure should have a designated owner who is responsible for the contents and the revision of the procedure.

6.4 Format: Wherever possible, a standard format should be adopted across the organisation for Operational Procedures. Each procedure should specify the objective of the issues covered and link to the relevant Element in the Process Safety Management Framework. Each procedure should also state:

- Where and when the procedure is to be used,
- Who the procedure applies to,
- How the work or actions in the procedure are to be performed, including performance criteria and the required sequence of actions (where relevant).

Operational procedures should take account of the potential for human error and should stipulate which actions are process safety critical tasks. In developing operating procedures account should be taken of human performance influencing factors. The style and language of each procedure should match the competence and language of the reader so that they may be readily followed and understood. Wherever possible, diagrams and illustrations should be used to assist the reader. Each procedure should be dated and contain information on who to contact if further information or clarification is needed.

6.5 Supplementary Procedures and Job-Aids: Substantive Operational Procedures should be supplemented by Method Statements and Works Orders for short term or non-routine work. Method Statements and Work Orders should meet the requirements set out in Section 6.4. They should be cancelled once the work is completed. For complex tasks, involving numerous stages, Operating Procedures should be supplemented by sequence-based job-aids which set out the condition to be achieved following each stage. Job-aides should stipulate the action to be taken if an abnormal condition occurs.

6.6 Engagement and Consultation: Representatives of the workforce, supervisors and managers responsible for compliance with procedures should be involved in their development and review. Employee representatives should be consulted on new or revised procedures before they are issued.

6.7 Communication and Availability: Operational Procedures should be available to all those who are required to comply with the procedure. Those required to comply with relevant procedures should be advised of the procedure and its applicability. Ideally, all procedures should be available electronically at each workplace/facility. Document control arrangements should be in place to ensure only the approved and current procedure is available. Procedures should include a version number to identify whether the procedure remains current. Hard copies of outdated or incorrect procedures should be routinely removed from the workplace. Information on new or updated procedures should be communicated to the workforce concurrent to their issue.

6.8 Training: When a new procedure is produced, or an existing procedure updated training and instruction on compliance should be provided to those affected by a new or revised procedure.

6.9 Review and Revision: Each procedure should be kept up to date, have an expiry date and a specified revision date. Arrangements should be in place to track and monitor the Operating Procedures review and revision programme.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o Examples of an operational procedures covering a safety critical tasks at the facility,
  - o Information of the progress with the Facility Operating Procedures review and revision programme
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where inadequacy of Operating Procedures was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 8: Operating Procedures and Manuals
2. HSE Guidance: Operating Procedures, https://www.hse.gov.uk/comah/sragtech/techmeasoperatio.htm
3. HSE Guidance. HSG48; Reducing Error and Influencing Behaviour. https://www.hse.gov.uk/pubns/priced/hsg48.pdf
4. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 10: Operational Procedures. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

7. Operational Control

Purpose: To ensure that the plant and processes are operated and maintained in a safe condition and sufficient safety margins are maintained. To ensure that the plant integrity is not degraded during start-up or operation and that the plant and processes can be safely shut down or brought under control in an emergency.

Minimum Expectations:

7.1 Designated Operational Parameters: The safe operational parameters for all plant, equipment and processes which can give rise to a major incident are clearly designated and documented. The information about process parameters and the basis of safe operation is readily available, in an understandable format, to those who need access to this information to maintain control of the plant and equipment.

7.2 Sufficient Competent People Available to Operate the Plant: There are sufficient people and equipment available whenever the plant and processes are operational or contain hazardous substances to keep the plant and processes within the designated safe operational parameters during start-up, operation and shutdown. Arrangements are made for absences and substitutions. Those people meet the competence specifications set out under Element 8. Competence Management. The safety critical tasks associated with maintaining operational control are set out and understood by those people who undertake those tasks.

7.3 Start-up: A pre-start up safety review is undertaken to ensure that plant and equipment is fit for purpose and re-commissioned to ensure safety during start-up. All safety critical items, instruments and alarms etc. are tested and shown to be functioning to their designated standard of performance and reliability prior to start-up. The critical stages of a startup are set out in job-aids or guides or integrated into control systems that provides information or prompts to staff to ensure they follow the correct procedure. The expected process / plant conditions for each stage of startup should be clearly set out.

7.4 Operational Control: The plant /processes are operated within their designated parameters and safety margins. There is appropriate control of interfacing operations where there may be a conflict between operational parameters that may jeopardise or compromise effective containment of hazardous substances or hazardous activities. The status of the plant and processes together with the correct valve positions, pump status and product flows, temperatures, levels and pressures etc. are provided to control room staff and available on the plant to allow operators to maintain the correct operational conditions. The Alarm Management Strategy ensures that alarm overloads and false alarms are eliminated or minimised. Appropriate action to bring the process conditions back into control following foreseeable deviations or abnormal conditions is clearly set out. Response times and priorities to alarms and warnings are followed.

7.5. Shut Down: Safe shut down is achieved by following a pre-determined sequence of actions. Job-guides or instructions are provided to staff setting out the key stages. Information on the plant and process conditions and equipment status is provided to staff at all times during shutdown. Information on abnormal conditions which could occur during shutdown and the action to take is available, understood and followed. Appropriate isolations are put in place following shut-down to ensure that dangerous substances or hazardous conditions are contained and will not endanger other processes, plant or people. Any person who considers the plant, process, equipment or activity not to be in a safe condition can initiate a plant shut down without seeking the approval of a more senior manager.

7.6 Emergency Actions: The actions to take in abnormal situations or emergency situations to ensure the plant or processes are made safe is clearly set out. The plant and process can be quickly brought to a safe state. Those actions which require manual intervention are documented and rehearsed in drills and exercises.

7.7 Shift Handover: There is a formal shift handover procedure which provides information on plant/process status and configuration. This should include any ongoing isolations, process or control system bypasses and disabled trips. The shift handover is logged and signed by the outgoing and incoming team. Sufficient time is allowed for shift handover to allow the effective exchange of information.

7.8 Process Information and Data: Information about process conditions and safety margins during start-up, operation and shutdown is recorded and analysed. Trends in variations from safety margins or beyond normal expectations, including process upsets are routinely reviewed by operational and maintenance managers on-site.

7.9 Review: The performance of the plant and processes during start-up, operation and shutdown is regularly reviewed by the site management team to ensure that the plant and processes are operated and maintained in a safe condition and sufficient safety margins are maintained.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o Start-up and shut-down procedures, including examples of completed pre-start checklists,
  - o Details of the normal staffing levels, shift patterns and competency standards for a shift leader, control room operator and, where relevant, shift technician,
  - o Examples of the identification of safety critical tasks and analysis of human reliability for a shift leader, control room operator and, where relevant, shift technician,
  - o Examples of data logs and trending analysis from start-up and operational periods, including conclusions on the analysis of this information,
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure to effectively manage start-up, operations or shutdown was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 9: Process and Operational status monitoring and handover, and Element 13: Operational Readiness and process start-up
2. HSE Guidance: Human Factors: Shift Handover: https://www.hse.gov.uk/humanfactors/topics/shift-handover.htm
3. HSE Guidance: RR446 – The Development of a fatigue / risk index for shift workers: https://www.hse.gov.uk/research/rrhtm/rr446.htm
4. HSE Guidance, HSG256: Managing Shift work: Health and Safety Guidance: https://www.hse.gov.uk/pubns/books/hsg256.htm
5. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 16: Operational Readiness, Element 17: Conduct of Operations. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

8. Competence Management

Purpose: To ensure that people have the right training, experience, skills and capacity to undertake process safety tasks to the desired standard of performance. To ensure that there are sufficient personnel and staffing levels to undertake all critical leadership, operational and maintenance tasks required to maintain the integrity of the plant and the processes. To routinely check and review people's performance. To ensure that contractors and third parties who fulfil a process safety role or function have the right competence.

Minimum Expectations:

8.1 Defined Organisational Structure: There should be a defined organisational structure for process safety risk management which clearly shows the interrelationships within the business of individuals with specific responsibilities for process safety.

8.2 Senior Managerial Responsibility: A member of the Facility or Business Unit Management team should be designated with accountability and authority for process safety.

8.3 Deployment of Competent People: People who perform safety critical roles should have the necessary skills and competencies to fulfil those roles.

8.4 Roles and Responsibilities: The roles, skills, capability and attributes of all staff who fulfil a safety critical function, including a leadership function, are clearly set out within job-specification documents. Each job-specification should state which safety critical role or task a post holder performs together with a description of the minimum level of skills, knowledge, experience and successfully completed training is required to fulfil that role. Posts or roles filled by contractors on a permanent or frequent basis should also be included.

8.5 Resourcing Capacity and Working Patterns: The minimum numbers of people required to fulfil key roles should be determined and clearly documented. This should be guided by a consideration of both operational needs and process safety critical tasks. Working patterns to ensure that there is sufficient resource capacity, including emergency response staff, available for each shift should also be set out. Recruitment and replacement programmes should take account of the current level of staff turn-over and the age-profile of the workforce and the expected capacity need in the future.

8.6 Recruitment and staff rotation: There should be a competence-based recruitment programme to match new staff to key roles involving a process safety critical function. Existing staff who take up different posts or changed roles which involve a safety critical function should be matched to the competence profile within the job-specification. Any gaps between the designated competences within the job-specification and those of a person in a new role or newly recruited to the company should be determined and a training plan developed to provide those competencies prior to the start of the new role. It is advisable to provide supervision for a new person in a safety critical role until a line manager is satisfied that the new person meets all the required competencies for that position.

8.7 Training and Development: A routine training-needs analysis programme should identify the training and experience needed for staff who perform safety critical roles. A training and development programme should be in place for those who are yet to achieve the desired standard of competence. The programme should also aim to improve skills and competencies in key roles beyond the minimum level of expectation. All staff who fulfil a process safety critical role should have at least basic training and knowledge on process safety risks and management. Basic Process Safety Training should include information on how human factors should be considered within a Process Safety Management Programme and how human error can contribute to a major incident. Specialist training should be provided for staff who have a role in the investigation of process safety incidents. Suitable refresher training should be provided. The training programme for all staff within a facility should be recorded as a training matrix.

8.8. Performance Evaluation: A performance agreement should be in place for people who fulfil a safety critical role. Their performance should be appraised at least annually. The postholder should produce evidence of how they meet the competencies set out in their job-specification.

8.9 Competence Programme Review: The adequacy of the Competence Management Programme should be routinely reviewed by the facility or Business Unit senior management team to ensure that the purposes of this element are met. Information reviewed should include; progress with the delivery of the training programme, gap-analysis against minimum standards of competences and staffing levels against the minimum capacity required, findings from incident investigations where inadequate competence was found to be a contributing factor.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
    - o Examples of job-descriptions for staff who perform a safety critical role, these should include a:
        - Plant Manager,
        - Team leader/ Supervisor,
        - Maintenance Manager,
        - Maintenance Technician,
        - Plant operator, and
        - Emergency responder.
    - o The current training needs analysis and training programme matrix,
    - o Anonymous copies of performance appraisal for:
        - Team Leader / supervisor, and a Maintenance Technician
- Once every 3 years conduct an independent audit (by a person external to the facility / business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where inadequacy in competence was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 3: Employee selection, placement and competency, and health assurance
2. HSE Guidance: HSG48: Reducing Error and Influence Behaviour, https://www.hse.gov.uk/pubns/books/hsg48.htm
3. Institute of Chemical Engineers, IChemE Safety Centre Guidance: Process Safety Competency –

4. a Model, 2015. https://www.icheme.org/media/1094/0007_18-competency_brochure-final.pdf
5. UK Office of Rail Road Regulation, ORR. Developing and Maintaining Staff Competence. https://orr.gov.uk/__data/assets/pdf_file/0016/4264/developing-and-maintaining-staff-competence-rsp1.pdf
6. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 5: Process Safety Competency. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

9. Management of Contractors

Purpose: To ensure that contractors and third parties who fulfil a process safety role or function have the right competence and have sufficient knowledge and information about process safety risks to undertake work safely and without degrading the integrity of the plant and process. To ensure there is a robust system of selection of contractors, to manage the change in contractor personnel and to ensure there is routine performance appraisal of contracted staff.

Minimum Expectations:

9.1 Selection and Appointment: There should be a documented procedure covering the arrangements for the selection and appointment of contractors. Contractors are appointed on the basis of their competence to undertake work safely. The selection is based on predefined criteria covering the process safety competence of the contractor and a demonstration that those competencies are met. Only appointed and pre-selected contractors are used for work on the facility which can affect the integrity of the plant and process.

9.2 Roles and Responsibilities: The roles and responsibilities for the selection, appointment and control of contractors should be clearly set out. Only staff competent to assess the process safety performance of contractors are appointed to designated roles.

9.3 Competence of Contractors: The selection and procurement procedure should specify minimum levels of process safety competence for Contracting Companies and for the individual contractor staff allocated to work.

9.4 Information and Instruction: Contractors should be provided with information and guidance on major hazards, process safety controls and emergency arrangements in advance of starting work on site. This information is in a format which can be readily understood by the Contractor and contracted staff. Induction training on major accidents process safety precautions and emergency arrangements is provided to all contractor staff prior to them starting work.

9.5 Control of Work: A written scheme of work, detailed working plans or safe working procedures should be prepared before any work which could affect the integrity of plant or equipment involving hazardous substances or conditions is undertaken by contractors. Method Statements should set out the sequence of work and resources needed. Method Statements and other written working procedures are authorised by an on-site manager or supervisor before work commences.

9.6 Supervision: The work of contractors should be supervised whilst on site undertaking work which could affect the integrity of plant or equipment involving hazardous substances or conditions. Periodic checks are made throughout the duration on the work to ensure that contractors are working in accordance with the authorised Method Statement or safe system of work. Feedback on performance should be provided to individuals and the Contracting Company Arrangements should be in place to stop or suspend the work if the Contractor fails to work in accordance with the authorised Method Statement or fails to comply with other safe systems of work.

9.7 Hand-Back and Recommissioning: The safety and integrity of plant and processes are checked once the work of contractors is completed before the plant or equipment is brought back into operation.

9.8 Compliance: Sanctions and formal warnings should be in place to be applied where the process safety performance of Contractors does not meet expected standards. Such sanctions should include suspension of the Contract, removal of contract staff from site and restrictions on the re-engagement of poor performing Contracts for future work.

9.9 Monitoring and Review: The process safety performance of the Contractor Management system should be regularly reviewed by the site senior management team and the procurement team (where these functions are separate). Information on adherence to safe working practices and systems of work gathered during the supervision of Contractors or from investigation of process safety incidents involving Contractors should form part of this review.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o A copy of the local policy on Management of Contractors,
  - o A copy of the process safety pre-selection criteria used prior to the appointment of a Contractor,
  - o Information on the types of sanctions which are imposed for poor process safety performance by Contractors,
  - o Examples of Contractor Performance Appraisal Reports,
  - o Examples of information and instruction on process safety risks and safe operating procedures relating to the work of Contactors,
- Once every 3 years conduct an independent audit (by a person external to the facility / business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure to effectively manage contractors was found to be an underlying cause or contributing factor to the incident.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 18: Contractor and Supplier Selection and Management,
2. HSE Guidance: Contractors https://www.hse.gov.uk/toolbox/workers/contractors.htm
3. HSE Guidance: Using Contractors – a brief guide https://www.hse.gov.uk/pubns/indg368.pdf
4. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 13: Contractor Management. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

10. Permit to Work

Purpose: To ensure that high risk maintenance activities are effectively controlled, and that people are not exposed to hazardous conditions. To ensure that work within scope of the PTW system is only undertaken following an adequate and proportionate risk assessment to determine the safe system of work and that the controls are validated before work commences.

Minimum Expectations:

10.1 Documented Permit to Work System: There is a documented Permit to Work Procedure in Place.

10.2 Scope: The scope of work or activities which require prior written authority clearly defined, set out and communicated. The scope of the PTW system specifies what activities are covered by the PTW system and the different types of permit required according to the activity.

10.3 Designated Roles and Responsibilities: Competent staff are designated for authorising a PTW request and for undertaking risk assessments. The designated person to authorise a PTW request is independent from a person who requests the permit.

10.4 Trained staff: All staff and contractors who undertake work covered by a PTW are trained in the PTW arrangements before they start work within the control of a PTW.

10.5 Risk assessment: A PTW should only be issued once an appropriate risk assessment is undertaken to determine whether the work is safe to undertake and if so, to identify the precautions to be taken and information required by those working within the permit. A record of the findings of the risk assessment should be kept.

10. 6 Permit Controls: The PTW authorisation should set out:

- The nature, sequence and location of the work,
- Who is authorised to undertake the work,
- Measures to make the work and workplace safe, including access and egress, isolations, and safe atmosphere,
- Overlaps and links with other work/PTWs which may be affected,
- Personal Protective Equipment to be worn,
- Information and warnings to others about risks,
- Emergency arrangements, and

  The maximum period of time for which the work is authorised.

10.7 Safe Isolations: Plant and equipment should be isolated and locked off in accordance with good practice. 'Lockout and Tagout' procedures should be used so that, wherever possible, each person undertaking work has their own equipment of hazardous plant isolation lock and key.

10.8 Working and Equipment Condition Checks: Checks should be undertaken to ensure that all the isolation and other safety measures specified in a PTW are in place before the work is started. Routine checks should be undertaken during the work to ensure that the specified precautions remain in place. These should include repeat checks on the atmosphere at the workplace where there may be toxic, flammable, corrosive or irritant vapours present or where there may be oxygen depletion or enrichment.

Checks should be made to the plant, equipment or process to ensure it has been restored to a safe condition and that all isolations have been removed prior to restart or recommissioning. Such checks should be undertaken by a person independent to those who undertake the work.

10.9 Authority to Stop Work in Dangerous Situations: Those engaged in work under the control of a PTW must be able to stop the work if there is any concern about or failure of the effectiveness of any of the precautions or isolations set out in the Permit. The work should also be halted if any serious hazard or risk not covered by the precautions set out in the permit is encountered during the work.

10.10 Permit Hand Over: A permit handover procedure should be in place where work is carried over to another shift to ensure that the incoming shift is aware of any outstanding permit-controlled jobs, the status of those jobs, and the status of the plant. Work-in-progress should be left in a condition that can be reliably communicated to, and understood by, the oncoming shift.

10.11 Permit Suspension: Where a PTW is suspended because the work is halted or interrupted the permit should be kept on the permit recording system. The condition in which the plant has been left and the consequences for other activities should be specified. The work should not be restarted until the issuing authority has verified that it is safe to do so and has revalidated the permit or issued a new permit.

10.12 Risk Communication and Information: The issue of a Permit should always be accompanied by a face to face discussion with all those involved in the work to inform them of the safety precautions, including the nature and locations of isolation, emergency arrangements, work duration and PPE required. A copy of the Permit should be displayed at the place of work, in the control room associated with the location and a copy kept by the issuing authority.

10.13 Review and Revision: The operation of the PTW system should be routinely reviewed by the site Senior Management Team to assess whether the control of high-hazard work is effective and that the system for authorising and issuing permits is efficient and does not lead to long delays.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o the local PTW procedure highlighted to show where each element of the expectation is located within the procedure,
  - o examples of a completed Risk Assessments and a completed example of each type of Permits in use at the facility,
- Each year complete the self-assessment questions set out in Annex 1 and rate current compliance,
- Highlight in any accident or incident investigation where a failure in the Permit to Work System was found to be an underlying cause or contributing factor to the incident,
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 17: Work Control PTW and task risk management.

2. HSE Guidance: HSG 85 Electricity at work Safe working practices
https://www.hse.gov.uk/pubns/priced/hsg85.pdf

3. HSE Guidance: HSG 253 The Safe Isolation of plant and equipment https://www.hse.gov.uk/pubns/priced/hsg253.pdf
4. HSE Guidance: HSG 250 Guidance on permit-to-work systems: A guide for the petroleum, chemical and allied industries https://www.hse.gov.uk/pubns/priced/hsg250.pdf
5. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 11: Safe Work Practices. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

11. Management of Change Purpose: All changes to plant, equipment, procedures and personnel which could have an adverse impact on
the safe operation and maintenance of plant and processes are assessed and approved under a formal management of change system before being implemented.

Minimum Expectations:

11.1 Documented Management of Change: There is a documented Management of Change Procedure in place.

11.2 Scope: The scope of what constitutes a change within the Management of Change procedure is clearly defined, set out and communicated. The scope of the application should include changes to plant, equipment, processes, control systems and set points, maintenance requires, operational and maintenance procedures, HSE Policies, organisational structure, job function and roles, working patterns which may have an adverse impact on the control of hazardous substances or hazardous condition.

11.3 Designated roles: Appropriate competent staff are designated as having responsibility for approving a Management of Change Request and for undertaking risk assessments. Only staff with appropriate level of training and competence are assigned these responsibilities. The designated person to approve a management of change request is independent from a person who requests a change.

11.4 Trained staff: All staff who may request a change or be required to implement an approved change are trained in the Management of Change Procedure.

11.5 Risk assessment: Changes are only approved once a suitable and sufficient risk assessment has been undertaken to determine whether the changes could have an adverse impact of the safe integrity of the plant, process or operations. Risk assessments are completed and recorded in accordance with NT-P-028.

11. 6 Designated change: Only the approved changes are implemented without further alteration. Changes to an approved project once underway are re-assessed before being finalised. Approval for changes are time-limited and are implemented within the agreed time period. Delays to implementation are tracked by the site/facility management team.

11.7 Like for like: Only changes of plant or equipment meeting the same performance standards as the original equipment are treated as 'like for like' and therefore do not require prior authorisation.

11. 8 Short-term or temporary changes: Do not remain in place for more than 28 days without a formal review by the person who authorised the change to determine whether the change remains necessary and valid. Existing temporary changes are reported to and tracked by the site/facility management team.

11.9 Validation before sign-off: Approved changes are validated as being in accordance with the initial request by the person who authorised the change.

11.10. Information Updated: Documents, diagrams, information and procedures are updated in line with the approved changes. Revisions are made as soon as possible. Outstanding/overdue updates are tracked by the site/facility management team.

11.11 Maintenance protocols updated: Relevant maintenance protocols, schedules and procedures are updated and implemented before the change is signed-off as validated.

11.12 Updated Training: Relevant training is provided for all staff affected by the change. Training is provided in a timely manner.

11.13 Benefits validated: The benefits or improvements claimed to be achieved in the initial proposal are reviewed and validated by the person who approved the initial request for change within 3 months of the change being implemented.

11.12 Change Approval Documented: Copies of Management of Change applications, risk assessments and validation confirmation are recorded, and records kept for 5 years.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - o the local Management of Change Procedure highlighted to show where each element of the expectation is located within the procedure,
  - o examples of a completed Management of Change Approval Record and risk ranking matrix covering a change to hardware, procedures and organisation,
- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Highlight in any accident or incident investigation where a failure to effectively manage change was found to be an underlying cause or contributing factor to the incident,
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 12: Management of Change and Project Management.

2. HSE Guidance: Plant modification / Change procedures,

www.hse.gov.uk/comah/sragtech/techmeasplantmod.htm

3. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 15: Management of Change. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

12. Emergency Arrangements

Purpose: To ensure that in the case of a developing emergency that the plant and processes can be safely shut down and controlled. To ensure that people are effectively evacuated from the facility or can reach a safe refuge in the event of an emergency. To ensure that on-site and external emergency responders have sufficient information, resources and capacity to deal with all foreseen emergency situations. To protect assets, neighbouring facilities and the surrounding environment from detrimental harm from an emergency situation. To facilitate appropriate clean up and recovery.

Minimum Expectations:

12.1 Emergency Plan: There should be a documented Emergency Plan, which sets out the arrangements for responding to emergencies at the facility. The Plan should focus on the preservation of life and should prioritise the safeguarding of people and the environment in the event of an emergency above that of safeguarding assets and business.

12.2 Scope: The Emergency Plan should be based on the foreseeable emergencies which could arise from each type of major incident scenario as set out in Elements 1 and 2. The Plan should state the action to take in the event of each identified major incident scenario which could occur on site and the location where such scenarios are likely to occur. The actions to be taken in an emergency should be based on the worst-case situation expected to arise from each major incident scenario.

12.3 Roles and Responsibilities: The roles and responsibilities for the development of the Emergency Plan, and for the roles to be delivered during each emergency scenario should be clearly established. Persons with designated roles should be trained and competent to undertake the role allocated to them. A Command and Control structure should be established to manage an incident and liaise with external responders.

12.4 Resources: The number of people required to fulfil each designated role within the Emergency Plan should be set out. The minimum number of designated staff responsible for responding to an emergency should be available on-site at all times or be capable of being called to site within a short period of time. Stand-by and additional support arrangements should be set out in the Plan.

12.5 Equipment: The location and type of equipment required to respond to an emergency should be set out in the Emergency Plan. Where emergency response equipment is provided to meet the objectives in the Plan, it should be sized according to the worst-case major incident scenario and located so that it is capable of rapid deployment. The Plan should set out how the emergency equipment is to be utilised during foreseeable emergencies. The emergency response equipment should be routinely inspected and maintained to ensure they remain fit for purpose.

12.6 Emergency Alarm: There should be a means of raising an Emergency Alarm to alert staff and contractors to an incident. Different types of alarm should be provided if the response to an emergency differs such as evacuate the site or stay indoors and close windows and doors. The action to take in an emergency should be routinely communicated to staff, contractors and visitors. The action to take in response to an off-site emergency should be clearly and regularly communicated to the local 'at risk' population.

12.7 Safe Evacuation Routes and Places of Safety: There should be dedicated and signed exit routes which lead to a place of safety or muster point. The exit routes inside buildings should be provided with emergency lighting.

12.8 Liaison with off-site Emergency Responders: The arrangements for liaison with external Emergency Services should be clearly set out. This should include the exchange of information on hazardous substances

and processes as well as the status of plant and equipment when the external Emergency Services arrive on site.

12.9 Training and Practice: Emergency exercises and practice drills should be held regularly. Wherever possible, such drills and exercises should involve the external Emergency Services. The findings and lessons learnt from the effectiveness of drills and exercises should be recorded and reviewed to identify improvements to the Emergency Plan and arrangements.

12.10 Containment ad Recovery: The arrangements to safely shut down and isolate hazardous processes to prevent escalation should be set out in the Emergency Plan. The emergency arrangements should ensure there is secondary and tertiary containment of losses of hazardous substances to prevent escalation. There should be a documented Spill Protection and Clean-up Plan. Arrangements should be in place for the engagement of specialist contractors, and where relevant Marine Pollution specialists, to clean up and recover from an incident and to safely dispose of any waste. The recovery arrangements should also cover mitigation and recovery from a cyber-attack.

12.11 Monitoring and Review: The emergency arrangements, resourcing equipment provision and maintenance and adequacy of the Emergency Plan should be regularly reviewed by the Facility or Business Unit Management Team to determine whether any improvements need to be implemented.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information A copy of the local Emergency Plan,
- A copy of the records of the inspection and maintenance of emergency equipment and emergency alarms for the previous 12 months, and
- A copy of the emergency drill and exercise programme for the next 24 months together with an example of the lessons learnt report from the most recent emergency exercise held on site,

- Once every 3 years conduct an independent audit (by a person external to the facility/business unit) of the implementation of this element,
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 14 Emergency Preparedness,
2. HSE Guidance: Emergency Procedures https://www.hse.gov.uk/toolbox/managing/emergency.htm
3. HSE Guidance: HSG 191 https://www.hse.gov.uk/pubns/priced/hsg191.pdf
4. HSE Guidance, Emergency Response Spill Control. https://www.hse.gov.uk/comah/sragtech/techmeasspill.htm
5. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 18: Emergency Management. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

13. Monitor, Measure and Review Purpose: To ensure that relevant information and intelligence is provided

to confirm that the process safety
management system is capable of providing the right level of risk reduction in a sustained way over the lifetime of the facility. To provide feedback on deficiencies and deterioration in control and mitigation measure in a timely manner to allow for problems to be fixed and lessons applied across the whole business. To facilitate appropriate monitoring and scrutiny by senior executives, the board and stakeholders (including regulators) that risks are being adequately controlled. To inform strategic priorities and improvement programs.

Minimum Expectations:

13.1 Systematic Monitoring of Performance: There should be a documented systematic approach to monitoring, measuring and reviewing the performance of the Process Safety Management system against the objectives set out in this framework. The performance monitoring programme should encompass incident investigation, using information from key performance indicators and audits to provide a comprehensive picture of performance.

13.2 Analysis and Review: The results of all performance monitoring programmes should be routinely reviewed by the Facility or Business Unit Senior Management Team to detect and determine where action is needed to improve performance and to acknowledge and recognise good performance. The findings from performance monitoring activities should be analysed for trends and common cause failings to determine whether, over time, the management of process safety risks is improving or deteriorating. The findings should be used to develop prioritised Improvement Plans where shortfalls in performance occur. The findings from incident investigations of events in other business facilities, and from national and international incidents which may hold relevant learnings for risk management within the facility should be reviewed by the Facility or Business Unity Senior Management Team.

13.3 Communication of Findings: The findings from monitoring of process safety performance programmes and any associated improvement plans or acknowledgement of good performance should be routinely communicated to the workforce, contractors and key stakeholders.

13.4 Roles and Responsibilities: The roles and responsibilities for performance monitoring, measurement and review, including trend analysis, should be clearly set out.

13. 5 Competence: Those with designated roles and responsibilities for performance monitoring, measurement and review set out in this Section should be competent to undertake their function. Training and guidance to those involved should be provided. The standard of competence required for each role or function should be stipulated in terms of experience, training and qualifications.

13.6 Incident Investigation - Scope: There should be a definition of a process safety incident which requires to be reported and investigated. The definition should encompass all events where there has been an actual or potential loss of containment of hazardous substances or a loss of control of dangerous conditions which gave rise to or could give rise to a major incident. A formal reporting process should be in place.

13.7 Conduct of Investigations: There should be a systematic investigation of all reported Process Safety incidents aimed at determining the immediate and underlying cause of the incident and identifying improvements. The investigation of Process Safety Incidents should not seek to apportion blame or guilt for the incident but to identify which element(s) of the process safety management system were sub-standard and the improvements required to prevent a recurrence. The extent and nature of the investigation should be proportionate to the actual or potential consequences. The Facility or Business Unit Senior Management Team should track the progress of the investigation of all but minor process safety incidents.

13.8 Key Performance Indicators - Scope: Routine information about the performance of the Process Safety Management System should be gained from a balance of both leading and lagging key performance indicators, KPIs. KPIs should be set to measure the effectiveness of each element of the Process Safety Management System.

13.9 Key Performance Indicators – Objectives: Lagging indicators should be set to measure the achievement of the outcome or objective of each element of the Process Safety Management System, as set out in this Manual, rather than simply measuring or counting the number or rate of process safety incidents. Leading indicators should be set to monitor and measure the completion and adequacy of the key inputs to each element of the Process Safety Management system which are essential to deliver the appropriate outcome. This should include ongoing assurance on how process safety critical tasks are performed.

13.10 Audit - Scope: There should be a programme of routine audits of the Process Safety Management System to ensure the all components of a Process Safety Management System are in place and functioning.. Internal, facility-based audits should be undertaken at least annually. At least every three years the PSM System at the facility should be audited by an independent body or by auditors from another facility.

13.11 Conduct of Audits: Audits should evaluate the strengths and weaknesses of each element of the Process Safety Management System and record the evidence used to determine the findings. Where improvements are identified they should be prioritised based on their significance to the delivery of the outcome of each element of the Process Safety Management System. Notwithstanding the overarching audit frequency set out in 13.9 above, the timing and nature of audits should be managed to ensure that further audits are not undertaken which could lead to an overload or excessive accumulation of outstanding action points for the facility.

13.12 Benchmarking: The Facility or Business Unit should benchmark its process safety performance against that of other facilities within the business and wherever possible, with that of other similar businesses with the same Industrial Sector. The Facility or Business Unit Management Team should actively seek examples of good practice in risk management from other organisations and institutions.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
  - A copy of the local Process Safety Incident Reporting and Investigation Procedure,
  - Information on the Leading and Lagging Key Performance Indicators in place, and
  - A copy of the process safety performance report routinely reviewed by the Facility Senior Management Team,
- Each year complete the self-assessment questions set out in Annex 1 and rate current compliance,
- Once every 3 years conduct an independent audit (by a person external to the facility / business unit) of the implementation of this element,
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 20 Audit Assurance Management Review and Intervention.

2. HSE Guidance: Investigating Accidents and Incidents https://www.hse.gov.uk/pubns/hsg245.pdf https://www.hse.gov.uk/toolbox/managing/emergency.htm
3. HSE Guidance: HSG 254 Developing Process Safety Key Performance Indicators- Step by Step Guide: https://www.hse.gov.uk/pubns/priced/hsg254.pdf
4. API Recommended Practice 754: Process Safety Performance Indicators For The Refining And Petrochemical Industries; https://www.api.org/oil-and-natural-gas/health-and-safety/refinery-and-plant-safety/process-safety/process-safety-standards/rp-754
5. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 19 Incident Investigation, E20: Measurement and Monitoring, E21 Audit, E22 Management Review and Continuous Improvement. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

14. Leadership and Culture

Purpose: To ensure that priorities and strategies for effective risk management are established, championed and implemented. To ensure sufficient resources for sustainable risk management are provided and that sufficient capital investment is provided to maintain the integrity of the plant and process as well as the management systems. To ensure that business decisions are made in the light of the implications for risk management and that stakeholders are informed and engaged on the performance of the business in relation to risk management. To ensure there is adequate and effective risk communication and visibility of senior managers is maintained to support and deliver a positive health and safety culture.

Minimum Expectations:

14.1 Process Safety Vision and Strategy: The Facility or Business Unit Senior Management Team endorse the Corporate Process Safety Vision and overall aims, objectives and principles of action to ensure a high level of protection of human health and the environment from major incidents and accidents.

14.2 Direction and Targets: There should be a documented Facility Process Safety Strategy which sets out how the Corporate Process Safety Vision is to be achieved and maintained on site. The Facility Strategy Document should set out the arrangements and control measures in place at the facility and for its operations to prevent major accidents and process safety incidents and to mitigate their consequences. The Facility Process Safety Strategy should confirm that the risk of a major accident or process safety incident is as low as is reasonably practicable, ALARP. The Strategy should include a time-bound plan for meeting the requirements of the Corporate Vision and Objectives.

14.3 Roles and Responsibilities: The roles and responsibilities of the Facility or Business Unit Senior Management Team and its commitment towards continuously improving the control of major incidents and accident should be clearly set out.

14.4 Senior Management Competence: The roles and responsibility of all managers, and their commitment towards continuously improving the control of major incidents and accident should be clearly set out. Process Safety leadership and governance skills and attributes are clearly defined and included in the job descriptions for managers. A member of the Senior Management Team has been designated with accountability and authority for process safety. The values of Process Safety Vision are demonstrated by the actions of managers and supervisors in their day to day work.

14.5 Corporate Oversight: The Senior Management Team are aware of and can describe in general terms the main process safety risks within the business. There is a demonstrable involvement by management at all levels in the development and implementation of the Facility Process Safety Strategy. The Senior Management Team assess the implications and potential impact of budget changes or organisational changes on the management of process safety risks. Reward and incentive schemes do not encourage production at the expense of process safety risks. Senior managers defer to the advice and expert opinions provided by specialist process safety personnel in ensuring that they get expert process safety input to aid decision-making. There should be a clear policy to stop work in any unsafe situation or in any situation where there is uncertainty of the safety of the plant, process or control systems.

14.6 Visibility and Engagement: Senior managers actively promote and support process safety risk management. All members of the Facility or Business Unit Senior Management Team routinely visit the workplace and hold and promote discussions on process safety. Representatives from all levels within the organisation are engaged in the planning of process safety objectives and improvement plans. At risk process safety behaviours and substandard conditions which have the potential to cause a major accident or process safety incident are identified and communicated to the workforce and contractors.

14.7 Sector Engagement: The Senior Management Team should actively engage with others within their sector to share good practice and information on process safety incidents that may benefit others. There should be arrangements in place to incorporate learning from others.

14.8 Communication of the Vision and Strategy: The Process Safety Vision Statement and Strategy should be clearly communicated at every level within the facility and to key stakeholders. Regular tool-box talks or Process Safety Briefings should be held with the workforce and contractors to communicate and refresh the importance of process safety risk management and to share the lessons / improvements from process safety incident investigations.

14.9 Monitoring and Reviewing Performance: The Facility or Business Unit Senior Management Team should receive routine information on process safety performance from the facility. This should include intelligence on good and sub-standard performance. The Senior Management Team should review this information against the Facility or Business Unit Process Safety Management arrangements to determine whether and where improvements in process safety risk management are needed.

14.10 Resourcing: The Senior Management Team should provide sufficient resources and funding necessary to deliver its Vision and Strategy. The development of CAPEX and OPEX budgets should reflect the agreed priorities and improvements in Process Safety Management.

14.11 Retention of Company Knowledge: Systems and arrangements should be in place to ensure the retention of corporate knowledge relating to process safety management. Such arrangements should include information on the basis of safety design concept of the plant and processes, plant and process changes, and any past incidents that impacted on process safety integrity and the improvements adopted to prevent a recurrence.

Demonstrating Compliance:

To demonstrate compliance with this element the Facility or Business Unit should:

- Have available and keep updated the following information:
    - A copy of the Facility Process Safety Strategy,
    - A copy of the Strategy Implementation Plan for the facility
    - Examples of process safety information reviewed by the Facility Senior Management Team.
- Once Every 3 years the OECD questionnaire should be completed by all members of the Facility or Business Unit Senior Management Team, a sample of senior managers and a sample of supervisors.
- Draw up and monitor an improvement plan to take account of any short fallings against this standard.

References:

1. Energy Institute Process Safety Management Framework – Element 1 Leadership.
2. OECD. Corporate governance for process safety: Guidance for senior leaders in high hazard industries. http://www.oecd.org/chemicalsafety/corporategovernanceforprocesssafety.htm
3. HSE Guidance: Process Safety Leadershsip Group, PSLG, Principles of Process Safety Leadership. https://www.hse.gov.uk/comah/buncefield/pslgprinciples.pdf
4. Centre for Chemical Process Safety: Guidelines for Risk Based Process Safety: Element 3 Process Safety Culture. Centre for Chemical Process Safety/AIChE ISBN: 978-0-470-16569-0

Appendix I: Glossary

AIChE	American Institute of Chemical Engineers
ALARP	As Low as Reasonably Practicable
ATEX	Atmosphère Explosible (EC directive 94/9/EC on explosive atmospheres)
BS EN	British Standard European Norm
CAS	Chemical Abstracts Service
CCPS	Centre for Chemical Process Safety
CCTV	Closed Circuit Television
COMAH	Control of Major Accident Hazards (UK legislation implementing the EC Seveso Directive)
ECHA	European Chemicals Agency
EI	Energy Institute
GHS	Global Harmonised Standard
HSG	Health and Safety Guidance
ISO	International Standards Organisation
IT	Information Technology
KPI	Key Performance Indicator
MoC	Management of Change
PID	Process Information Diagramme
PSM	Process Safety Management
PTW	Permit to Work
SIMOPS	Simultaneous Operations
UN	United Nations


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Experience
Counts